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Pac, David Frank
Production and survival of mule deer bucks in mountain-foothill habitats (mule deer research-Pac)

# Production and Survival of Mule Deer Bucks

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## Bridger Mountains

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*Progress Report*
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JOB PROGRESS REPORT

RESEARCH PROJECT

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| STATE: | Montana | | |
| PROJECT NO: | W-100-R | TITLE: | Statewide Wildlife Research |
| STUDY NO: | 1 | TITLE: | Big Game Research |
| SUBPROJECT NO: | BG-1 | TITLE: | Deer |
| JOB NO: | 3 | TITLE: | Production and survival of mule deer bucks in mountain-foothill habitats (Mule Deer Research - Pac) |

Period Covered: July 1, 1992 - June 30, 1993

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Date: September 30, 1993

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## INTRODUCTION

The MDFWP has experienced increasing public demand to improve and diversify mule deer buck management in seven of eight administrative regions. In March 1985, the Montana Fish and Game Commission asked the Wildlife Division to evaluate the status of "big bucks and bulls" available to hunters. A special report entitled Antlered Elk and Deer Management in Montana was presented to the Commission in December 1985 summarizing past trends, current status, and management strategies. Since that time, continuing public concern has fostered changes in the mule deer buck season structure in 15 of 170 (9%) hunting districts distributed across regions 2, 3, 4, 5, and 6. Season types employed to improve buck availability include limited entry permit hunts during all or a portion of the season, various antler point restrictions, season length shortened to 3 weeks, and season-long either sex hunting. These season types have been implemented without the benefit of a recent statewide review or comprehensive plan for addressing this problem.

Solving these management challenges will require new knowledge concerning the factors that determine production and mortality of mule deer bucks. Earlier studies have indicated that populations can vary in their potential to support large numbers of adult bucks (Pac et al. 1991). Although hunting contributes significantly to total annual buck mortality, other factors such as predation, winter-related losses, and emigration may be important in some populations. Understanding these relationships is critical to defining the problem of low buck availability and finding appropriate management solutions.

In 1990, research on mule deer bucks was initiated in the Bridger Mountains because of the extensive baseline data available on mule deer in this southwestern Montana mountain range. Also, the Bridger Range (HDs 312 and 393) is generally representative of hunting units along the Continental Divide where buck management problems have occurred.

## RESEARCH OBJECTIVES

1. Determine cause and rate of mortality of mule deer bucks in two populations occupying different environments in the Bridger Mountains.

2. Provide new or improved methods for monitoring mule deer bucks.

3. Develop and test "new" types of buck hunting seasons.

4. Formulate populations goals and harvest strategies that can be used as a template for other less intensively studied mountain-foothill populations.

The principle focus of this report will be a preliminary evaluation of the experimental 2-point mule deer season implemented in HD312 in 1989. Population

composition, natural mortality rates, distribution patterns, and physical measurement data will also be discussed.

## STUDY AREA

The Bridger study area (Fig. 1) has been described in nauseating detail by Pac et al. 1991.

The Bridger Mountain Range is a semi-isolated frontal range on the eastern flank of the Northern Rocky Mountains. It includes most of the topographic, climatic, and vegetation types that characterize the interface between the Rocky Mountains and Great Plains. Maximum evaluations vary from 2400 m on the southern and northern ends of the range to 2947 m on Sacajawea and Naya Nuki Peaks near the center. Slopes along the west side are steep with many inclined over 30° or more, meeting the Gallatin Valley floor at 1700-1800 meters. The north and east flanks of the Bridger Range consist of moderately dissected benchlands and undulating foothills that reach Sixteen Mile Creek and the Shields River at 1340-1365 m.

The climate of the area generally resembles that of a middle latitude steppe (Lutgens and Tarbuck 1982). Conditions are semi-arid with relatively long cold winters and short cool summers. Within these general patterns, orographic and elevational factors cause significant local variation in climate and weather patterns across the study area. Average annual precipitation increases sharply with elevation from 40-45 cm. annually along the western footslopes to an estimated 127 cm. along the Bridger Divide, then declines progressively along the east and north flanks. Overall, precipitation is lower along the eastern foothills than in the Gallatin Valley.

Vegetation in the Bridger Range consists of an "island" of forest within a "sea" of steppe. Three major vegetation zones occur: 1) steppe - open grassland and shrub-grassland communities; 2) montane forest - dominated by Douglas fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), white-bark pine (*Pinus albicaulus*), limber pine ( *Pinus flexilis*), subalpine fir (*Abies lasiocarpa*), or spruce (*Picea engelmanni*); 3) a subalpine-alpine zone along the Bridger Divide.

Most of the study area, including nearly all of the steppe zone and about one-half of the foothill area is privately owned. Lands above the lower limit of forest are predominately of public ownership administered by the Gallatin National Forest. Along the east flank of the main Bridger Range, ownership occurs in a checkerboard pattern with alternating sections of private timber company lands.

Grazing, dryland grain and hay production, and rural residential development are the primary uses of private land. Major uses of national forest includes timber harvest, livestock grazing, and recreation.

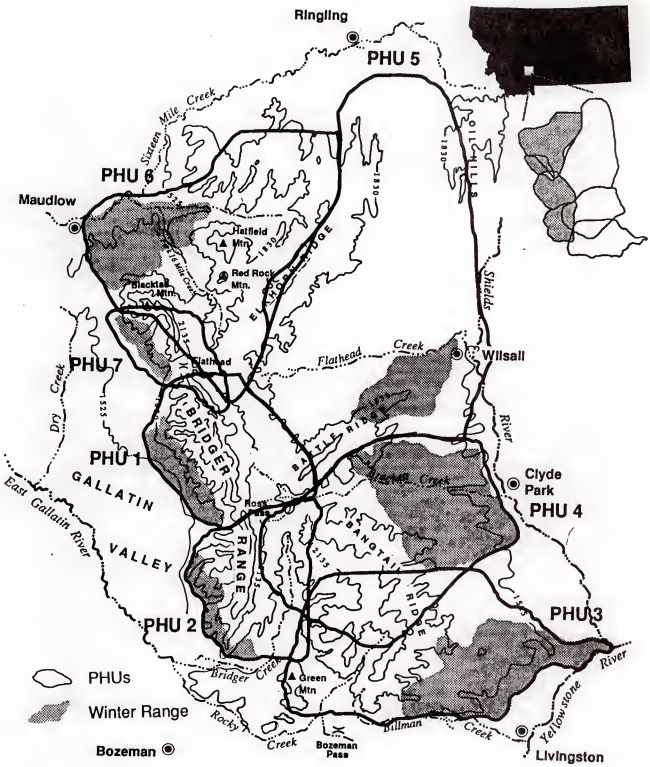


Figure 1. The Bridger study area and location of seven mule deer population-habitat units (PHUs). Current research efforts center on PHUs 1, 2, 6, and 7.

Pac et al. (1991) documented that mule deer were distributed in seven population-habitat units (PHUs) within the Bridger Mountain Complex (Fig. 1). Each PHU represented a rather distinct association of individual deer bonded together by traditional use of individual home ranges within a definable unit of yearlong habitat. PHUs 1, 2, and 7, centered in the west Bridger range, collectively represent one of two study units in the current research effort. Historically, this study unit has supported a sizeable component of mature bucks. It is currently under the two point regulation (HD312) which allows the legal harvest of any antlered mule deer buck during the first three weeks of the general big game season. Only spike or two-point bucks are legal during the last two weeks.

The second study unit centers in PHU6 in the Sixteen Mile basin along the north flank of the Bridger Range. Environmental characteristics and deer population dynamics provide contrast with that of PHUs 1, 2, and 7. Hunting regulations in PHU6 and the remainder of HD393 allow harvest of any antlered mule deer buck for the entire five week season.

## METHODS

A total of 509 mule deer was captured, marked, and released during the winters of 1990-1993 in PHUs 1, 2, 6, and 7 in the Bridger Mountains (Table 1). Capture techniques included helicopter drive-netting, clover trapping, corral trapping, helicopter net-gunning, and darting from a helicopter with carfentinal. A total of 160 male fawns, 88 adult bucks, and 16 female fawns received radio collars and metal ear tags. Male fawns were fitted with Telonics MOD400 or MOD500 transmitters on CB5 expansion collars (12-30 inch expansion range). This package was superior to Wildlife Materials HLPM21100 transmitters on pleated elastic straps that were used in conjunction with a second observation collar of Armortite material. Adult bucks were marked with black or white PVC collars in 1990 and 1991. These have been gradually replaced by an expansion collar we designed to accommodate growth and neck circumference changes during the rut. This new package is called a Soares collar. Nearly all transmitters included a mortality sensor. Most radio packages used on either adult bucks or male fawns are difficult to see on the animal. Favored colors include black, brown, and gray so as not to bias hunter or predator selectivity. Females were marked with individually color-coded observation collars constructed of Ritchey material and metal ear tags.

At time of capture, we recorded sex, age to nearest year class, chest girth for fawns, and took a blood sample when feasible.

Blood samples of adult females were tested for pregnancy using level of protein B (Sasser et al. 1986). Also, blood chemistry, whole blood, and disease parameters were measured at the MSU Veterinary Research Lab.

Table 1. Number of mule deer captured, marked, and released in four population-habitat units in the Bridger Mountains during 1990-1993.

| | | Adult Female Neck-banded | Adult Males Radio-collared | Adult Males Neck-banded | Male Fawns Radio-collared | Male Fawns Neck-banded | Female Fawns radio-collared | Female Fawns neck-banded | |
|---|---|---|---|---|---|---|---|---|---|
| 1989-90 | PHU1 | 11 | 7 | - | 3 | - | - | 1 | |
| | PHU2 | - | 1 | - | - | - | - | - | |
| | PHU7 | 17 | 11 | - | 13 | - | - | 3 | |
| | PHU6 | 19 | 15 | 1 | 20 | 2 | - | 10 | |
| 1990-91 | PHU1 | 6 | 3 | - | 3 | - | - | 9 | |
| | PHU2 | - | 1 | - | - | - | - | - | |
| | PHU7 | 12 | 7 | - | 13 | - | - | 7 | |
| | PHU6 | 19 | 3 | 2 | 20 | - | - | 22 | |
| 1991-92 | PHU1 | 3 | 2 | - | 3 | - | - | 4 | |
| | PHU2 | - | 5 | - | - | - | - | - | |
| | PHU7 | 11 | 9 | - | 14 | - | - | 9 | |
| | PHU6 | 11 | 2 | - | 25 | - | - | 15 | |
| 1992-93 | PHU1 | 3 | 10 | - | 8 | - | - | 4 | |
| | PHU2 | - | 3 | - | - | - | - | - | |
| | PHU7 | 11 | 4 | - | 8 | - | - | 11 | |
| | PHU6 | 11 | 5 | 1 | 20 | - | - | 19 | |
| 1990-1993 Total | PHU1 | 30 | 22 | - | 25 | - | 3 | 18 | |
| | PHU2 | - | 10 | - | - | - | - | - | |
| | PHU7 | 51 | 31 | - | 43 | - | 4 | 30 | |
| | PHU6 | 45 | 25 | 3 | 92 | 2 | 9 | 66 | |
| West Slope Study Unit | PHUs 1, 2, 7 | 81 | 63 | 0 | 68 | 0 | 7 | 48 | |
| South 16 Mile Study Unit | PHU 6 | 45 | 25 | 3 | 92 | 2 | 9 | 48 | |
| | Total | 126 | 88 | 3 | 160 | 2 | 16 | 114 | 509 |

We attempted to radio collar 25 male fawns on an annual basis in each of the study units during early winter. Additional samples of 10-20 adult bucks were also radio collared in each study unit.

Radio-collared deer were relocated two to three times per month from a Piper Supercub during May - December and once per month during January-April. All relocations were plotted on 1:15840 or 1:24,000 scale air photos. Relocations were assigned UTM coordinates and elevation to the nearest 30 meters. Movement data were analyzed using Telday software. During January-April, deer are confined to their winter ranges and transmittered deer are easily monitored for mortality signals by ground reconnaissance from a 4-wheel drive vehicle at least once per week.

As soon as a mortality signal is received from aerial or ground monitoring during any season, the transmitter is recovered expeditiously and cause and timing of mortality is determined. Carcass and site characteristics are photographed. Sex, age, estimated date of death, cause of death, description of the carcass, diagnostic characteristics such as tooth marks, signs of trauma, etc., and site description is recorded on site on a standardized form. Of the 244 male fawns and adult bucks that have been radio collared during 1990-1993, death or dispersal has eliminated 139 (57%) as of June 30, 1993. Forty-six are alive and wearing functional transmitters. The fate of the remaining 59 are unknown.

Population trend and composition are determined from full coverage helicopter surveys during early and late winter in PHUs 1, 2, 4, 6, and 7 or a representative portion of this area. Population composition of the HD312 population (PHUs 1, 2, 7) is also compared to that of PHU4 (Brackett Creek) in HD393 where long-term trend data are available. Numbers, sex, age, antler class, group size, elevation, and general location is recorded from all observations. Identity of all marked deer observed is attempted. Calculation of population estimates from marked samples has been hindered by the use of collar colors on bucks that are difficult to observe.

Annual hunter harvest was monitored by randomly selecting 400 Bridger deer hunters from statewide harvest survey databases. Hunters were only chosen from nearby cities and towns in Gallatin and Park Counties. Each hunter was sent a letter prior to the season opening that requested them to call a 1-800 toll free buck-kill report line after successfully harvesting a mule deer buck in HD312 or HD393. After notification of a kill, we made a house call to obtain age, weight, and antler measurements.

## RESULTS AND DISCUSSION

### Buck Distribution

Mule deer bucks were captured and monitored in PHUs 1, 2, 6, and 7 during 1990-1993. A line connecting summer and winter activity centers for each of 52

individuals 1 year or older is displayed in Fig. 2. Some individuals marked in winter 1993 are not included because analysis is incomplete. These data for adult males ($\geq$ 1 year) are superimposed over the seven population-habitat units delineated from the seasonal movements of 297 adult female mule deer in the Bridger Mountains as reported by Pac et al. (1991).

Post Season Buck:Doe Ratios

The 20-year record of post season buck doe ratios (Fig. 3) for the Northwest Slope population (HD312) provides an overview of the dynamic changes that take place in the buck segment over time.

Although hunting exerted an important influence on the trends portrayed in Fig. 3, natural mortality also contributed significantly to the variation displayed on the graph. Any management strategy in this environment must contend with periods when strong cohorts predominate, followed by years when cohorts are weak. Availability of bucks during any one year is governed by the dynamic influence of natural mortality and hunter harvest. Significant numbers of 3- and 4-point bucks were available to hunters during 1973-1976 with a secondary and lower peak of availability in the early 1980s.

To evaluate changes in buck:doe ratios in HD312 during the 2-point season, we will simply use a 4-year period prior to the change followed by a 4-year period under the new regulation (Fig. 4). The 1985-1988 period represented the bottom of the trough in availability of bucks. During those years, ratios of 3- and 4-point antlered bucks:100 does were the lowest ever recorded on the West Slope numbering between 2 and 4:100 does. High hunting mortality of yearling and older bucks was the suspected cause of this problem because recruitment of yearling bucks was occurring at average or above average rates in those years.

After the 2-point season was initiated in 1989, a general trend toward improving buck:doe ratios is indicated for the 1989-1991 period in Fig. 4. Numbers of 3- and 4-point bucks increased to 9:100 does in 1991, and all antlered bucks reached 26:100 does. These levels approximated the buck availability associated with the "good old days" of years past. However, by the close of the 1992 season, buck:doe ratios had again declined to comparatively low levels.

In HD393, where the hunting season remained the same, buck:doe ratios for the Brackett Creek population generally displayed less variation and approximated long-term trends (Fig. 5). The decrease in ratios of all antlered bucks:100 does between 1988 and 1989 was attributed to high fawn mortality during the severe winter of 1988-89. In this population where the buck segment contains only a few year classes, the recruitment of a weak cohort results in a pronounced decline in buck availability. The only other notable variation in buck:doe ratios during 1985-1992 in HD393 was a moderate increase in 3- and 4-point bucks during 1992 (Fig. 5).

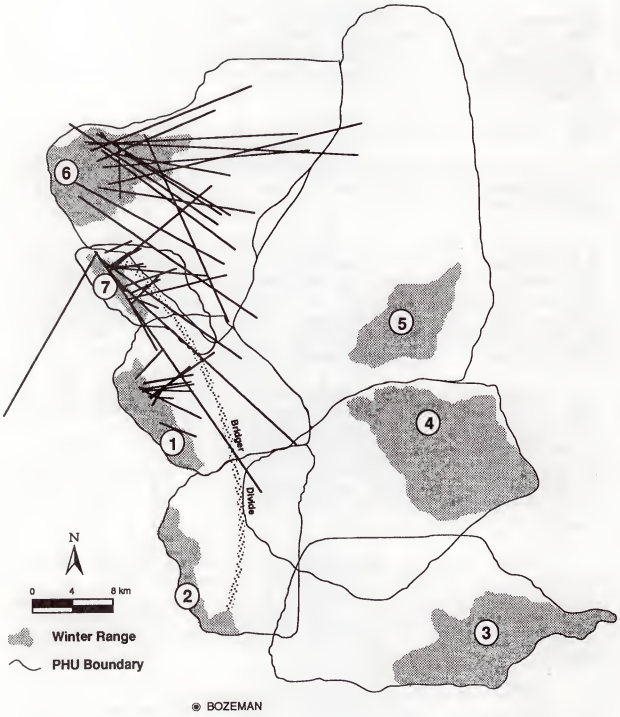


Figure 2. Distribution of 52 mule deer bucks ($\geq$ 1 year old) that were radio-tagged in PHUs 1, 2, 6, and 7 in the Bridger Mountains. Each line connects winter and summer activity centers of an individual buck.

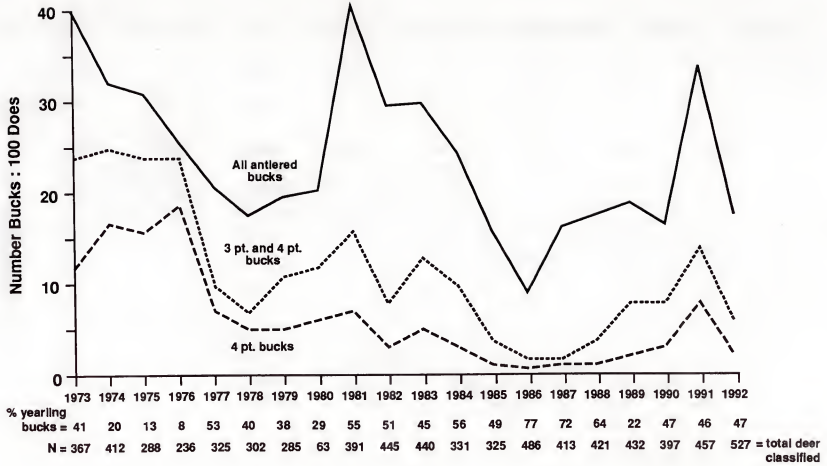


Figure 3. Post season mule deer buck:100 doe ratios for the Northwest Slope population (portion of HD312), 1973-1992 in the Bridger Mountains.

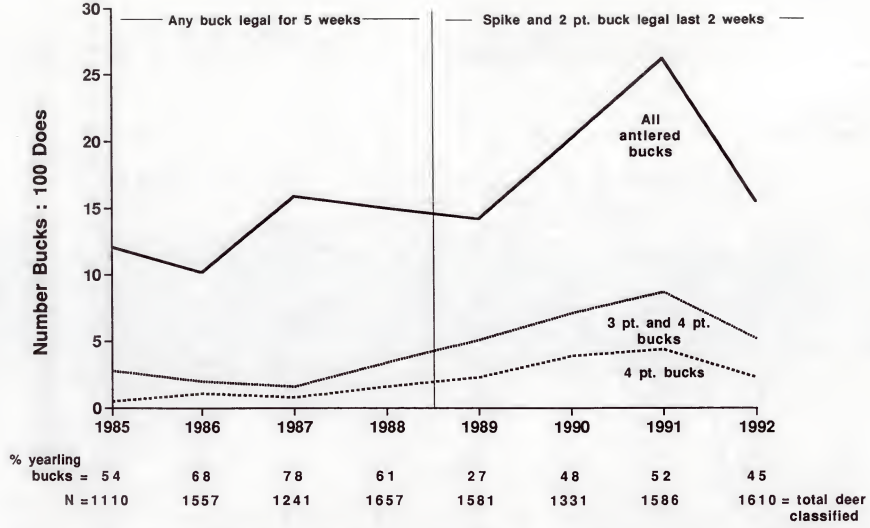


Figure 4. Post season mule deer buck:100 doe ratios for the entire west slope of Bridger Mountains (HD312), 1985-1992.

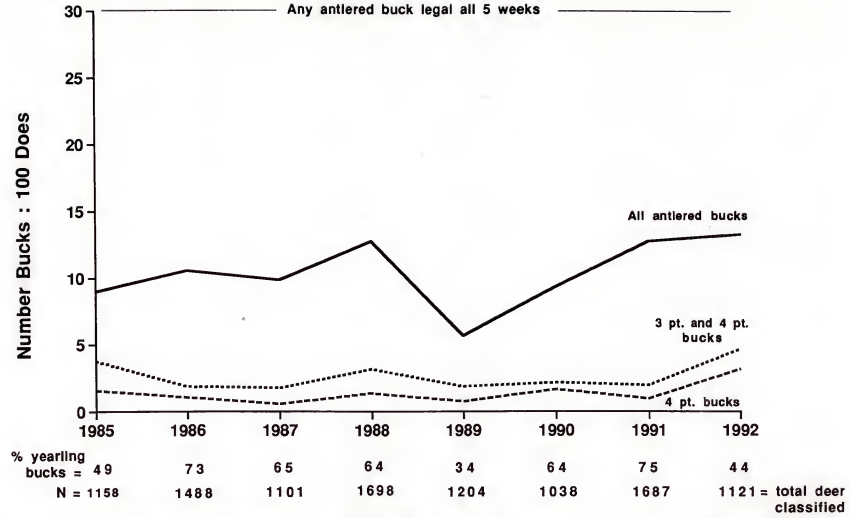


Figure 5. Post season mule deer buck:100 doe ratios for the Brackett Creek population (portion of HD393), 1985-1992.

Let us examine the post season buck:doe ratio data in HD312 from the perspective of a mule deer buck hunter who is familiar with the rugged country in the west Bridgers. Using post season sex and age composition data for the deer population during 1984-1992, I computed how many antlerless deer a hunter must observe before probabilities favor him seeing a 4-point or larger buck (Fig. 6). In Fall 1985, a hunter had to observe 17 antlerless deer before he could expect to see a 4-point buck. With a little luck, this could be accomplished during one "good day" of hunting. During 1986-1988, when public concern was peaking over the buck problem, a hunter had to encounter 60-75 antlerless deer before probabilities favored observing a 4-point. This might require 4-5 days of hunting effort to accomplish. Under the 2-point season, the number of antlerless deer a hunter needed to encounter before seeing a 4-point declined from 38 in 1989 to 19 in 1992 (Fig. 6). Once again, a hunter had a good chance of seeing at least one 4-point in a one day hunt in 1992. This opportunity will decline to 30 antlerless deer before a 4-point is seen this next fall.

Ages of Harvested Bucks

Ages of bucks harvested in HD312 and HD393 during 1989-1992 were obtained from randomly selected Bridger deer hunters who were sent a letter to call FWP if they killed a buck. Each year, we sent out 400 letters. After being notified of a kill, we made a house call to obtain age, weight, and antler measurements.

For general comparison, Fig. 7 shows age data for HD312 and HD393. Data were pooled for 1989-1990 and 1991-1992. During 1989-1990, bucks 5 years and older made up only 3% of the sample in HD312 and 5% of the sample in HD393. The 1991-1992 data show that this proportion increased to 25% in HD312 after four years of the 2-point regulation. In HD393, the proportion of 5 year and older bucks did increase to 11% in 1991-1992, but this was a lower magnitude of change compared to that of HD312.

Fig. 8 illustrates age data collected during 1989-1990, 1991, and 1992 in HD312. Sampling required pooling the first two years under the 2-point regulation. As mentioned above, only 3% of bucks harvested in those years were 5 years or older. This increased to 12% in 1991 and 31% in 1992. The 1992 age distribution can be considered "well developed" for this population.

Apparently, the 2-point season in HD312 did result in an increase in 5 year and older bucks that was above and beyond a "natural" trend that was also favoring somewhat greater availability of these age classes.

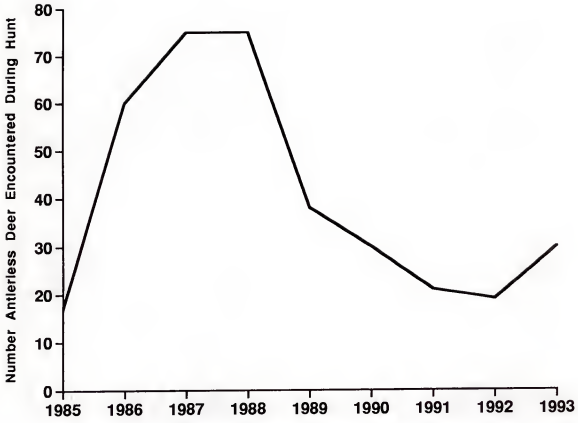


Figure 6. Number of antlerless mule deer that must be seen while hunting before a 4-point mule deer buck is observed in HD312, 1985-1993.

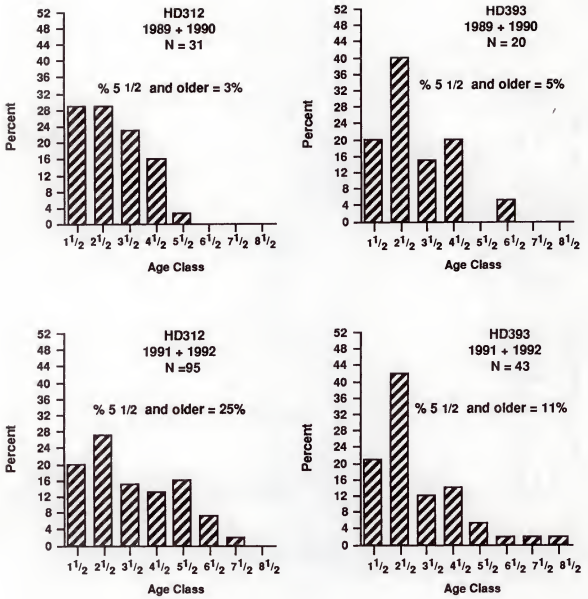


Figure 7. Comparison of randomly collected age distributions of mule deer bucks harvested in HD312 and HD393.

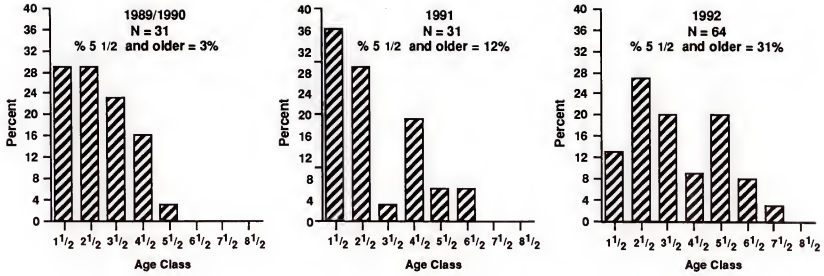


Figure 8. Randomly collected age distributions of mule deer bucks harvested in HD312 during 1989-1990, 1991, and 1992.

Mortality of Radio Collared Bucks (6 mos. and older)

Each winter from 1990-1992, we radio-collared 6 month old male fawns and "representative" numbers of older bucks on two study areas in the Bridgers. The entire west slope served as the HD312 study area under the 2-point season. The South 16 Mile area served as a comparative study site under the 5-week season where private land restricted hunter harvest.

The data in Table 2 summarizes mortality rates that are pooled across years for the two study areas during the winter, spring, and summer seasons. This was intended to provide an overview of the "average" magnitude of natural losses that occurred during the three seasons prior to the fall hunting season. During winter, fawn losses were 28 and 29% on the two study areas. However, the predominant cause of loss was different. Winter-kill took greater numbers of fawns on the west slope, and predation (primarily coyotes) was the important decimator on South 16 Mile. Winter losses of adult bucks varied from 4% on the West Slope to 9% on South 16 Mile. Predation and winter-kill operated on both areas.

In spring, a much greater fawn mortality rate (44%) occurred on South 16 Mile compared to the West Slope (14%). Coyote predation was the important cause of death on both areas. Adult buck losses were 1% on the West Slope and 6% on South 16 Mile. Predation by coyotes and cats were the principal cause of death on both areas.

Mortality rates and causes were very similar on both areas during summer. Yearling male losses averaged 14%, and mature buck losses were 2-3%. Predation was the principal agent of death on both areas.

The net effect of these mortality rates during winter, spring, and summer can be visualized when applied to a cohort of 100 deer starting on January 1 (Tables 3 and 4). Starting with 100 male fawns on the West Slope on January 1, mortality will diminish that number to 53 yearling bucks by September 30. Only 34 yearling bucks will remain on September 30 on South 16 Mile. Similar computations are provided for adult bucks on the two areas (Table 4). After natural losses during winter, spring, and summer, 93 adult bucks remain in the West Slope population compared to 83 adult bucks in the South 16 Mile population.

In the nine months prior to the hunting season, natural mortality removed a significant proportion of each fawn/yearling buck cohort between 6 months and 1½ years of age. Losses are higher on the South 16 Mile area, primarily because of higher coyote predation. Natural losses of adult bucks are relatively low on the West Slope and moderate on South 16 Mile. Predation is responsible for most adult losses on both areas.

Table 2. Mule deer buck mortality during winter, spring, and summer for the West Slope study area (HD312) and South 16 Mile (HD393). Data are pooled for 1990, 1991, 1992, and 1993.

| Study Area | Radio Sample | Cause of Mortality During Season | % Mortality |
|---|---|---|---|
| WINTER (January - March) N=4 years | | | |
| West Slope | Fawns = 64 | 10 winter kills, 4 coyote, 2 mt. lion, 1 bobcat, 1 road kill | 28 |
| | Adult bucks = 108 | 1 coyote, 1 mt. lion, 1 unclassified predator, 1 winter kill | 4 |
| South 16 Mile | Fawns = 77 | 14 coyote, 4 unclassified predators, 1 mt. lion, 2 winter kills, 1 accident | 29 |
| | Adult bucks = 55 | 3 coyote, 2 winter kills | 9 |
| SPRING (April - June) N=4 years | | | |
| West Slope | Fawns = 43 | 3 coyote, 1 winter kill, 1 unclassified death, 1 accident | 14 |
| | Adult bucks = 99 | 1 mt. lion | 1 |
| South 16 Mile | Fawns = 48 | 17 coyote, 2 winter kills, 1 uncl. death, 1 possible dispersal | 44 |
| | Adult bucks = 49 | 1 coyote, 1 bobcat, 1 winter kill | 6 |
| SUMMER (July - September) N = 3 years | | | |
| West Slope | Yearling bucks = 28 | 1 mt. lion, 1 black bear, 1 unclassified predator, 1 possible dispersal | 14 |
| | Mature bucks = 65 | 1 mt. lion | 2 |
| South 16 Mile | Yearling bucks = 21 | 1 coyote, 1 archery kill, 1 unknown death | 14 |
| | Mature bucks = 31 | 1 mt. lion | 3 |

Table 3. Winter, spring, and summer mortality rates applied to a cohort of 100 male fawns starting on January 1 on West Slope and South 16 Mile.

| Date | West Slope Study Area | South 16 Mile Study Area |
|---|---|---|
| January 1 | 100 male fawns | 100 male fawns |
| | (28% mortality) | (29% mortality) |
| March 31 | 72 male fawns | 71 male fawns |
| | (14% mortality) | (44% mortality) |
| June 30 | 62 yearling bucks | 40 yearling bucks |
| | (14% mortality) | (14% mortality) |
| September 30 | 53 yearling bucks | 34 yearling bucks |

Table 4. Winter, spring, and summer mortality rates applied to a cohort of 100 adult bucks (1½+ years) starting on January 1 on West Slope and South 16 Mile.

| Date | West Slope Study Area | South 16 Mile Study Area |
|---|---|---|
| January 1 | 100 adult bucks | 100 adult bucks |
| | (4% mortality) | (9% mortality) |
| March 31 | 96 adult bucks | 91 adult bucks |
| | (1% mortality) | (6% mortality) |
| June 30 | 95 adult bucks | 86 adult bucks |
| | (2% mortality) | (3% mortality) |
| September 30 | 93 adult bucks | 83 adult bucks |

Mortality during the fall season is portrayed by year for the two study areas in Table 5. On the West Slope study area in HD312, mortality rates of yearling males under the 2-point regulation have averaged about 30%. This includes some minor natural losses during and after the hunting season. However, sample sizes of yearling males are small for individual years.

Harvest rates of mature (2½ yr.+) bucks on the west slope varied from 33% in 1990 and 1991 to 65% in 1992. The comparatively low harvest rates in 1990 and 1991 contributed to the upward trend in buck:doe ratios during those years (Fig. 4). The high rate of harvest in 1992 precipitated the declines in post season buck:doe ratios shown in Fig. 4.

A total of three illegal kills of older bucks during the 2-point portion of the season have been recorded among the radio sample. This represents 12% of the legal kill. However, radio samples may be avoided by hunters taking illegal bucks.

Fall mortality on South 16 Mile has averaged 31% among mature bucks and only 6% for yearling bucks. In addition to hunting mortality, a few predation losses were recorded among mature bucks during fall on South 16 Mile (Table 5).

Statewide Harvest Survey

Data from the Statewide Harvest Survey for HD312 and HD393 are presented in Tables 6 and 7. During the four years (1985-1988) prior to initiation of the 2-point season in HD312, number of hunters increased about 9%, while hunter days increased by nearly 25%. For 1989, the first year of the 2-point season, number of hunters decreased by 24%, and hunter days declined by 20%. During 1990-1992, number of hunters and hunter days gradually increased to levels similar to 1988, the last year of the five-week any buck season in HD312.

The number of mule deer bucks harvested in HD312 during 1985-1988 varied between 477 and 501 (Table 6). The harvest during the first year of the 2-point season declined by 34% to 325 and remained low through 1991. In 1992, the buck harvest increased sharply to 570. This high harvest was generally consistent with the sharp increase in the harvest of the radio-collared sample during the same year.

Proportions of 4-point and larger mule deer bucks recorded during the statewide harvest survey for HD312 averaged 41% during both the four year period before the 2-point season and the four-year period after implementing the new regulation. These data were not sensitive enough to reveal changes in availability of older, larger antlered bucks that was evident in the age distribution data presented in Figs. 7 and 8. Obviously, antler point data collected by the Statewide Harvest Survey cannot distinguish a 4-point buck that is 2 years old from a 4-point that is 7 years old.

Table 5. Mule deer buck mortality during the fall season (October 1 - December 31) on the West Slope and South 16 Mile during 1990, 1991, and 1992.

| Study Area | Radio Sample | Cause of Mortality | % Mortality |
|---|---|---|---|
| 1990 | | | |
| West Slope | Yearling = 5 | 1 cripple loss | 20 |
| | Mature = 9 | 3 hunter kills | 33 |
| South 16 Mile | Yearling = 5 | 0 losses | 0 |
| | Mature = 12 | 4 hunter kills, 1 coyote | 42 |
| 1991 | | | |
| West Slope | Yearling = 9 | 3 hunter kills | 33 |
| | Mature = 22 | 6 hunter kills, 1 cripple loss, 1 illegal kill | 36 |
| South 16 Mile | Yearling = 5 | 0 losses | 0 |
| | Mature = 7 | 1 illegal kill | 14 |
| 1992 | | | |
| West Slope | Yearling = 9 | 1 illegal kill post season, 1 mt. lion, 1 unclassified death | 33 |
| | Mature = 31 | 17 hunter mills, 1 probable unreported hunter kill, 1 illegal kill, 1 possible illegal kill | 65 |
| South 16 Mile | Yearling = 7 | 1 probable unreported hunter kill | 14 |
| | Mature = 7 | 1 possible illegal hunter kill, 1 coyote kill | 29 |
| 3 YEARS COMBINED | | | |
| West Slope | Yearling = 23 | 3 hunter kills, 1 cripple loss, 1 illegal post season, 1 mt. lion, 1 unclassified death | 30 |
| | Mature = 62 | 26 hunter kills, 1 cripple loss, 1 probable unreported hunter kill, 3 illegal kills | 50 |
| South 16 Mile | Yearling = 17 | 1 probable unreported hunter kill | 6 |
| | Mature = 26 | 4 hunter kills, 1 illegal kill, 1 possible illegal kill, 2 coyote kill | 31 |

Table 6. Hunting pressure and mule deer buck harvest statistics for HD312, 1985-1992[1].

| | Number Hunters | Number Hunter Days | Total Bucks Harvested | Percentage 4-point or greater Bucks Harvested |
|---|---|---|---|---|
| 1985 | 1,866 | 7,615 | 490 | 46 |
| 1986 | 1,952 | 7,577 | 501 | 36 |
| 1987 | 1,916 | 9,650 | 477 | 33 |
| 1988 | 2,031 | 9,346 | 480 | 39 |
| 1989 | 1,536 | 7,449 | 325 | 36 |
| 1990 | 1,825 | 9,034 | 360 | 42 |
| 1991 | 1,853 | 7,677 | 369 | 40 |
| 1992 | 2,074 | 9,587 | 570 | 45 |

[1] Data obtained from Statewide Deer Harvest Survey. Nonresident and resident data are pooled.

Statewide survey data for HD393 (Table 7) show trends in number of hunters, hunter days, buck harvest, and percentage of 4-point bucks that are generally similar to those described for HD312. This similarity occurred even though the buck season in HD393 remained the same throughout the eight year period. In part, some of this similarity may be attributable to the often overriding influence that "good and bad" years in fawn survival can have on buck population dynamics in these two adjacent units. For example, a very weak yearling male component predominated in populations occupying HD312 and HD393 during 1989. This may have significantly contributed to the downward trend in buck harvest and hunting pressure in both units. Improved fawn survival contributed to rebounding trends in these parameters in both hunting units during 1990-1992.

Physical Condition Parameters

Carcass Weight

Eviscerated carcass weights of mule deer harvested in October and November in the Bridger Mountains are compared to other populations in Table 8. Weights from the Bridger Mountains and Missouri Breaks for yearling males and adult females (2½ years and older) were virtually identical. Mean weights of adult males (2½ years and older) were 2.5 Kg. heavier in the Missouri Breaks. Both of these populations exhibited higher mean weights compared to the Cherry Creek population in eastern Montana. However,

Table 7. Hunting pressure and mule deer buck harvest statistics for HD393, 1985-1992[1].

| | Number Hunters | Number Hunter Days | Total Bucks Harvested | Percentage 4-point or greater Bucks Harvested |
|---|---|---|---|---|
| 1985 | 1,550 | 6,783 | 513 | 58 |
| 1986 | 1,370 | 5,156 | 487 | 35 |
| 1987 | 2,038 | 8,196 | 521 | 39 |
| 1988 | 1,904 | 8,071 | 574 | 35 |
| 1989 | 1,366 | 5,584 | 367 | 47 |
| 1990 | 1,746 | 7,409 | 412 | 45 |
| 1991 | 1,790 | 7,484 | 493 | 34 |
| 1992 | 2,008 | 8,384 | 717 | 47 |

[1] Data obtained from Statewide Deer Harvest Survey. Nonresident and resident data are pooled.

small sample sizes in the latter population may have contributed to this discrepancy. In general, mean weights from Utah were slightly less than those recorded in Montana. All sex and age classes in the New Mexico populations weighed substantially less than Utah and Montana mule deer. This relationship generally follows Bergmann's Rule which predicts increasing body weight at the more northerly portion of a species' range.

Heart Girth Measurements

A linear relationship between chest circumference immediately behind the axilla (heart girth) and body weight has been demonstrated for white-tailed deer (Smart et al. 1973). Heart girth measurements for mule deer fawns in the Bridger Mountains are summarized in Table 9. Within the two populations, differences between the sexes were minimal. Mean girth measurements for fawns on the west slope were slightly larger than recorded for the South 16 Mile population during 1990, 1991, and 1992. The reverse occurred in 1993.

Antler Characteristics

Yearling bucks in the Bridger Mountains had fewer total antler points than yearling bucks in the Missouri Breaks or East Bitterroots (Table 10). Also, beam length was shorter in the Bridger Mountains compared to similar data collected in the Bitterroot.

Table 8. Eviscerated carcass weights of Rocky Mountain mule deer from selected localities in Montana and across the subspecies range.

| Locality | Sex | Age (mos.) | Sample Size | Eviscerated Carcass Wt. $\bar{X}$ SD (Kg.) | Weight Range | Season of Collection | Source |
|---|---|---|---|---|---|---|---|
| Bridger Mountains Southwest Montana | M | 16-17 | 45 | 42.6±4.6 | 36.3-56.7 | Fall | Pac, unpubl. data |
| | M | 27+ | 129 | 65.0±12.4 | 32.7-96.1 | Fall | |
| | F | 16-17 | 9 | 34.7±4.5 | 28.1-40.8 | Fall | |
| | F | 27+ | 69 | 43.7±6.1 | 34.0-65.8 | Fall | |
| Missouri River Breaks Northcentral Montana | M | 16-17 | 179 | 42.8±2.7 | 30.4-54.9 | Fall | Hamlin and Mackie 1989 |
| | M | 27+ | 286 | 67.5±11.8 | 43.5-102.5 | Fall | |
| | F | 16-17 | 41 | 37.3±1.9 | 29.5-47.6 | Fall | Hamlin, unpubl. data |
| | F | 27+ | 132 | 43.7±2.0 | 33.1-53.5 | Fall | |
| Cherry Creek Eastern Montana | M | 16-17 | 23 | 38.4±5.6 | 29.5-49.9 | Fall | Wood, unpubl. data |
| | M | 27+ | 30 | 55.4±7.0 | 40.8-72.6 | Fall | |
| | F | 16-17 | 10 | 33.2±3.1 | 29.5-39.5 | Fall | |
| | F | 27+ | 45 | 38.5±4.2 | 31.7-47.6 | Fall | |
| Oak Creek, Utah | M | 16-17 | 622 | 40.6 | 28.6-53.1 | Fall | Robinette et al. 1977 |
| | M | 27+ | 698 | 62.7 | 35.8-98.0 | Fall | |
| | F | 16-17 | 272 | 36.9 | 21.8-45.8 | Fall | |
| | F | 27+ | 627 | 42.3 | 28.6-59.4 | Fall | |
| Sacramento Mts. New Mexico | M | 15-17 | 167 | 32.8±4.5 | 23.1-45.8 | Fall | Anderson et al. 1964 |
| | M | 27+ | 330 | 52.6±13.1 | 29.9-87.5 | Fall | |
| | F | 15-17 | 136 | 28.4±3.1 | 21.3-39.5 | Fall | |
| | F | 27+ | 607 | 35.8±4.3 | 26.3-54.9 | Fall | |

Table 9. Heart-girth measurement (inches) for mule deer fawns captured during December 15-March 15 in PHUs 1, 2, 6, and 7.

| | | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|
| West Bridger Range - PHUs 1, 2, and 7 | | | | | |
| Males | $\bar{X}$ | 30.4 | 31.6 | 30.2 | 30.4 |
| | n | 15 | 18 | 16 | 16 |
| | Sx | 1.5 | 1.3 | 1.6 | 1.5 |
| | Range | 28.0-34.0 | 29.0-33.0 | 27.5-33.5 | 29.0-33.0 |
| Females | $\bar{X}$ | 30.4 | 31.2 | 30.3 | 29.7 |
| | n | 11 | 16 | 13 | 15 |
| | Sx | 1.0 | 1.4 | 1.6 | 1.6 |
| | Range | 29.0-32.0 | 29.0-33.5 | 27.0-33.5 | 27.0-32.5 |
| South 16 Mile | | | | | |
| Males | $\bar{X}$ | 29.9 | 30.8 | 29.4 | 20.9 |
| | n | 18 | 26 | 24 | 20 |
| | Sx | 1.7 | 1.7 | 1.5 | 1.1 |
| | Range | 27.0-33.0 | 28.0-34.0 | 26.0-31.0 | 29.0-32.5 |
| Females | $\bar{X}$ | 30.2 | 29.3 | 29.3 | 30.6 |
| | n | 17 | 20 | 14 | 19 |
| | Sx | 1.3 | 1.1 | 1.4 | 1.3 |
| | Range | 28.0-32.0 | 27.5-31.0 | 27.0-32.0 | 29.0-33.0 |

Table 10. Antler characteristics of yearling mule deer bucks at various points along the habitat spectrum in Montana.

| Location | Habitat Type | Total Antler Points | | Beam Length (mm) | | Beam Diameter (mm) | |
|---|---|---|---|---|---|---|---|
| | | $\bar{X}$ | N | $\bar{X}$ | N | $\bar{X}$ | N |
| East Fork Bitterroot (HD270) | Western Conifer Forest | 3.78 | 945 | 258.1 | 908 | | |
| Bridger Mountains | Mountain-foothill | 3.72 | 72 | 240.7 | 51 | 17.4 | 73 |
| Missouri Breaks | River Breaks | 3.86 | 365 | -- | -- | 17.9 | 311 |

Basal beam diameter was less for yearling bucks in the Bridger Mountains compared to beam diameters collected in the Missouri Breaks.

Disease Parameters

Blood samples collected from 240 mule deer captured in the Bridger Range during 1990-1993 were tested for four different diseases (Table 11). All tested negative for brucellosis. One male fawn (#7107) captured in PHU7 during 1991 was seropositive for blue tongue and anaplasmosis. A total of five individuals (2.1%) were positive reactors for leptospirosis. Of these, three (7116, 7142, 7147) captured in PHU7 were seropositive for *Leptospira grippotyphosa*, two (6183, 6202) captured in PHU6 were seropositive for *Leptospira hardjo* and *Leptospira antumnalis*, respectively.

Table 11. Results of disease testing of blood serum collected from 240 mule deer in the Bridger Mountains during 1990-1993.

| | Disease Type | | | |
|---|---|---|---|---|
| | Brucellosis | Blue Tongue | Anaplasmosis | Leptospirosis |
| No. Samples Tested | 240 | 240 | 240 | 240 |
| Seronegative | 240 | 239 | 239 | 235 |
| Seropositive | 0 | 1 | 1 | 5 |
| % Seropositive | 0 | 0.004 | 0.004 | 0.021 |

These diseases did not appear to contribute significantly to either mortality or reproductive problems in these populations. Seropositive status indicates that the individual had been exposed to the disease and had developed antibodies against it. It does not mean that the disease was active in the animal at the time the blood sample was collected.

## PRELIMINARY CONCLUSIONS

1. Hunter harvest rates of adult bucks were effectively reduced during the first three years of the 2-point season, 1989-1991. This harvest effect appeared to significantly enhance a "natural recovery phase" in buck availability that was fueled by above average recruitment during 1990 and 1991.

2. The 2-point season improved buck age diversity in HD312 until Fall 1992 when hunter harvest sharply increased to 65%. This high harvest reduced buck:doe ratios and diminished age diversity to levels that approached pre-treatment conditions.

3. It has taken four years for the buck population to have time to recover. It has also taken four years for hunters to adapt to the 2-point season. In the next few years, the magnitude and age diversity of the harvest will provide opportunity to judge the merits of this season. If harvest rates continue at the high levels recorded in 1992, then we will not be successful in meeting our stated goals of providing about 25 bucks:100 does with 40% of the harvest exceeding 3½ years of age.

4. Illegal kills of older bucks documented during the 2-point portion of the season have been relatively low.

5. Natural mortality rates are high in this buck population and are probably characteristic of that environment.

6. Any management strategy must contend with substantial annual variation in production of bucks.

7. Antler point data collected by the Statewide Harvest Survey were not sensitive enough to detect actual changes in antler size of bucks harvested at the hunting unit level.

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